USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Physical Effects of Flood Flows on Seedling Growth and Survivorship: Comparative Responses of Native Riparian Trees and Shrubs to Saltcedar

Focus Categories: ECL, FL, WL

Keywords: 14, 37, 81, 125, 176, 201, 206

Duration: The work will begin as soon as the grant is awarded and will be completed by February 2000.

FY 1999 Federal Funds: $ 6979

FY 1999 non-Federal Funds: $17,831

Principal Investigator's Name and University: Juliet C. Stromberg, Arizona State University

Congressional District of the University Where the Research is to be Conducted: Districts 1, 3, & 4

Statement of Critical Regional or State Water Problems

Many native riparian forests in Arizona have declined in productivity, species diversity, and extent. Altered water regimes have caused much of this degradation. Dams and diversions modify surface flow rates, flood periodicity, and sediment and nutrient transport, to the detriment of many riparian plants. Groundwater pumping has lowered water tables in some regions below adequate levels to sustain common native dominants, such as Fremont cottonwood (Populus fremontii) and Goodding willow (Salix gooddingii).

Many of the water regime changes inhibit recruitment of native plants and provide colonization opportunities for more opportunistic, stress-tolerant, or xerophytic plants. Biodiverse riparian forests often are replaced by homogenous stands of "weedy" native plants or exotic species.

One invasive exotic shrub, saltcedar (Tamarix chinensis), has taken over many regulated and otherwise managed river reaches, despite considerable attempts at control. However, Tamarix has been declining unaided along perennial reaches of the San Pedro River where hydrologic conditions have recently shifted to favor establishment of native cottonwood and willow species (Stromberg 1998). This conversion demonstrates that self-repair remains possible in damaged riparian ecosystems, if we can reinstate some key environmental factors that have been altered or eliminated.

Statement of Results or Benefits

Riparian ecosystem management cannot be successfully attempted without at least a basic knowledge of the interactions between various components within the system. Whether that management directs the operations of a hydroelectric dam, a municipal reservoir, or an agricultural irrigation system, managers could benefit from increased knowledge of the systems being affected by their decisions.

During the course of this research project we will seek to identify physical flood components (i.e., scour and sedimentation) that would enable seedlings of Populus fremontii, Salix gooddingii, and Baccharis salicifolia to sustain greater survivorship and growth rates than Tamarix chinensis. This information could prove invaluable to restoration work by allowing conscientious managers to actively manipulate key factors, like flood timing, scour potential, and sediment load, to enhance growth of their target species while discouraging growth of undesirables, like Tamarix. Once the flood tolerance thresholds of all prominent woody riparian species have been identified and related to floods of specific magnitude, velocity and duration, managers should be able to facilitate establishment of multiple desired species by prescribing appropriate flow-releases. The prescribed flood need not be optimal for each target species, but simply within all tolerance ranges. In the same way, it should also be possible to exclude exotic vegetation from these riparian areas by breaching their tolerance thresholds.

Along with its population, Arizona's demand for municipal and agricultural water, hydropower, and aquatic recreation continues to grow. The time for management compromise has arrived. We need to adopt strategies that will both protect our natural resources and allow sustainable human use. Results of this study should allow for continued flow-regulation on dammed rivers, while also allowing for the return of natural flood flows, paramount in the regenerative process of native riparian woodlands.

Nature, Scope, and Objectives of the Research

Managers of some dammed rivers, like the Bill Williams in Arizona, are attempting to restore native vegetation by prescribing controlled flood flows (Shafroth 1998; study funded partly by UA-WRRC). Some of these efforts have achieved notable success, by timing spring flood flows to coincide with the germination phenology of the target species. Further success in restoration of native riparian tree species and reduction of exotic species could be achieved by prescribing post-germination (e.g., summer) flood flows.

Unregulated streams of the arid southwest typically carry high sediment loads. Sediment deposited on young seedlings by mid-season floods can kill them, as can scour. Native seedlings have high stem growth rates which may reduce the likelihood of complete sediment burial by monsoon-driven flood-flows. Similarly, rapid root elongation would provide some insurance against being dislodged by scouring flows. Because flow in southwestern rivers is driven by an unusual, bi-modal precipitation pattern (i.e., winter

plus summer rains), native riparian tree species may be better adapted to withstand mid-summer floods than exotics accustomed only to spring floods from snow melt.

There is a need for further research on the comparative effects of flood scour and sedimentation on the growth and survivorship of native and exotic riparian plant seedlings. It may be possible to prescribe floods that preferentially facilitate growth and survivorship of native species. If tolerance ranges to flood components were known for variously-aged seedlings, desired species could be managed for with greater versatility as appropriate floods could be released at nearly anytime throughout the season.

Objectives of this study are: 1) to quantify seedling growth and survival thresholds of four dominant woody riparian species (Populus fremontii, Salix gooddingii, Baccharis salicifolia, Tamarix chinensis) in response to (a) simulated flood scour, (b) sediment burial, (c) water availability, and (d) soil texture; and 2) to contribute information necessary for development of an effective long-term plan to curtail further colonization by Tamarix and to help re-establish native riparian forests on managed Arizona rivers.